



# The incidence of non-linear price-dependent consumption taxes



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## ABSTRACT

The present article generalizes economic literature on the incidence of consumption taxes to general schedules of consumption taxes dependent on price. Previous studies were limited to the cases of per unit and ad valorem taxes. Three main contributions are made. Methodologically, the elasticity of the tax function is introduced as a new parameter so that the price-elasticity of general consumption tax schedules in different models of imperfect competition might be dealt with in a tractable manner. Theoretically, existing results on the difference between the incidence of ad valorem and per unit consumption taxes are generalized to non-linear consumption taxes: the larger the elasticity of the tax function, the smaller the share of consumption tax borne by consumers. From the perspective of applied public economics, it is shown how the regulator may reduce prices in very uncompetitive markets by increasing the elasticity of the consumption tax on a targeted range of producer prices.

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## 1. Introduction

Taxes are not always borne by the agent intended by fiscal authorities. This has been an issue of economic analysis at least since Quesnay (1759) argued that each and every tax levied under the French ancient régime was ultimately borne by landlords. Subsequently, Smith (1776) and Ricardo (1821) identified the way in which various taxes were borne by different agents (e.g.: luxury good consumers, landlords, and capitalists – at least for that share of profit not representing a risk premium), the question of tax incidence thereby becoming a major issue of economic analysis. For consumption taxes, there is an extensive literature dealing with ad valorem and per unit taxes, but there is little on more general consumption taxes. The aim of the present paper is to remedy this gap, generalizing existing economic literature on the incidence of consumption taxes to general forms of price-dependent tax schedules.

Consumption tax schedules are generally dependent upon price, and not on quantity: consumption is mainly anonymous, so tax schedules cannot be related to the quantities purchased. Hamilton (1999) analyzed the regulation of oligopolies with consumption tax schedules related to the entire market output. Tax schedules of this kind lack one of the main advantages of consumption taxes: the payment of tax

at the point of each transaction. Hence the present paper analyzes the impact of consumption taxes whose schedules depend on the actual producer prices for the transaction.

Furthermore, this paper derives no results regarding a normative optimal tax outcome: before embarking on such normative analysis it is necessary to fully understand the actual market impact of general price-elastic consumption tax schedules, which is what this paper aims to do through positive analysis.

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The incidence of taxation is of major importance as much for reasons of equity as for those of efficiency. It measures the way a tax burden is shared between different economic agents (producers and consumers in the case of consumption taxes), determining the distributive impact of taxation. It also measures the way in which consumption taxes affect total output, and consequently the deadweight loss of indirect taxation.

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Standard results state that under perfect competition in the long run, consumers bear the whole tax burden; but that it may be shared with producers in the short run, or when competition is imperfect (Fullerton and Metcalf, 2002). In the latter case, the consumer share of the tax burden decreases with respect to the elasticity of demand, and increases with respect to the elasticity of the marginal cost of production (Carbonnier, 2008). Furthermore, tax incidence depends on the structure of competition, and the consumer share may even be greater than 100%. This has been confirmed theoretically by Stern (1987) and Besley (1989) for homogenous products and Anderson et al. (2001a, 2001b) for heterogeneous products; it has been also empirically confirmed (Besley and Rosen, 1999; Kenkel, 2005; Young and Bielinska-Kwapisz, 2006; Carbonnier, 2007, 2008, 2014; Nakamura and Zerom, 2010).

Furthermore, the shape of the tax schedule itself influences its incidence. This was observed early on in the economic literature: in the early XIXth century, Cournot (1838) established that there was a difference between the incidence of per unit and ad valorem consumption taxes under monopoly. Since then, only these two forms of consumption tax have been studied: they are equivalent under perfect competition, but consumers bear a larger share of unit taxes than ad valorem taxes under imperfect competition. Wicksell (1896) demonstrated this result in the case of a monopoly with constant marginal costs, Suits and Musgrave (1953) for more general monopolies, Delipalla and Keen (1992) for Cournot oligopoly with conjectural variations and Anderson et al. (2001a, 2001b) for Bertrand oligopoly with horizontal heterogeneity. It has been empirically confirmed by Delipalla and O'Donnell (2001) and Carbonnier (2014) using respectively the European tobacco market and the French alcoholic beverage market.

The intuition behind this result is quite simple. The amount of per unit tax paid is the same regardless of the actual producer price. However, an ad valorem tax decreases per unit purchased if the producer reduces its own price. Hence, ad valorem consumption taxes subsidize producer price reductions, adding a tax reduction to the producer price reduction. This incentive makes price reduction more profitable for producers in the case of ad valorem consumption taxes than in the case of per unit taxes, and leads to lower consumer prices for the same level of tax revenue.

Nevertheless, these two kinds of taxes are not the only possible tools for taxing consumption, and more complex schemes might be established. The intuition about the per unit/ad valorem result foregrounds the importance of the price-dependency of the consumption tax schedule. Shilling (1969) has already proposed this idea, but he did not model the incidence of such taxes. Tam (1991) tried to model it in the monopoly case, but did not consider the possibility of equilibrium with negative profits (see the controversy between Sumner, 1993; Tam, 1993). More recently, Vetter (2013) has developed a model of tax incidence in monopoly taking account of the sum of a per unit tax on each transaction, plus directly taxing the monopoly depending on the market price. In the case of monopoly, this is equivalent to a tax on total output (e.g.: Hamilton, 1999).

Consumption taxes other than unit or ad valorem actually exist. A special schedule was introduced for the French tax on oil (TIPP for *Taxe Intérieure de Consommation sur les Produits Pétroliers*, interior tax of consumption of oil product) between October 1st 2001 and July 21 2002, and the possibility of reintroducing this still exists. The schedule was a per unit tax whose value decreased if the Brent crude price went up (floating TIPP). More generally, governments may wish to use fiscal tools to smooth the price volatility of certain very price-volatile goods. This necessitates consumption taxes varying in the opposite direction compared to producer prices, leading to very low price-elasticity of the tax function. The present paper demonstrates that such tax schemes would be inflationary.

Another example is less obvious. Some goods are subject to a mix of unit and ad valorem taxes, whose price-dependency is exactly those of the unit part of the mix. Hence, a mix of positive ad valorem tax and

negative unit tax can generate arbitrarily large price-elasticity of the tax function. Myles (1996) analyzes the optimal mix of unit and ad valorem taxes in a closed Cournot oligopoly framework. As the optimal consumer price is well-known – Ramsey price – the optimal tax mix consists in setting full price control through infinite elasticity of the tax function: a negative unit tax set at the optimal marginal revenue for producers and an ad valorem tax tending towards infinity.

If such a tax schedule is unrealistic, a large range of realistic ones may be considered. Less extreme cases of mixed taxation is one example. Other examples are the existence of two rates of taxation – a low rate for low prices and a large rate for large prices – with a window of producer prices where the tax rate continuously increases from the low rate to the large rate. The price-elasticity of such schedule is large within this targeted window and depends positively on the tax rate differential and negatively on the window's length. Such a tax schedule may be used to target a range of producer prices rather than setting a fixed price-cap or full control price for regulating uncompetitive markets. It can be useful for regulating oligopolies with heterogeneous costs or when the costs are unknown to the regulator. Indeed, actual costs of production are better known to regulated firms than to a regulator (Breyer (1982) shows it for the US telecommunication market and Koskow and Schmalensee (1986) for energy, see Joskow (2014) for a survey of literature on incitative regulation).

Furthermore, subsidizing a market is equivalent to imposing a negative consumption tax. Yet, the motive for subsidy – usually equity rather than efficiency – can lead to complex subsidy schedules, which can correspond to a large scale of price-dependency. For example, the French policy to answer social needs of dependent elderly consists among other schemes in the subsidy of elderly care services (APA: *Allocation Personnalisée d'Autonomie*, individualized allocation for autonomy). However, the actual calculations of the allocation differ from one *département* to another and Bourreau-Dubois and Gramain (2014) show that it corresponds to allocation per purchased hour of service increasing with respect to the price of service in some *départements* and decreasing in others. The elasticity of the tax function would be a useful tool to measure the price-dependency of such allocation schemes and infer their impact on prices.

The present article presents incidence outcomes for every price-elastic tax schedule in a large range of uncompetitive market models. It depends mainly on a useful parameter measuring the price-elasticity of the tax schedule: the elasticity of the tax function. Different models of imperfect competition are introduced to interpret the impact of this parameter on the incidence of consumption taxes.

The remainder of the article is composed as follow. Section 2 introduces the elasticity of the tax function and gives some examples of its value for different existing or potential consumption tax schedules (Section 2.1); then the theoretical methodology – which is a local demonstration – is presented (Section 2.2) and illustrated by the straightforward examples of perfect competition and monopoly: the elasticity of the tax function has no impact under perfect competition, but the consumers' share of the tax burden decreases with respect to the price-elasticity of the tax schedule under monopoly. Section 3 demonstrates the same result in the case of markets for homogenous goods, both in the short run (closed Cournot oligopolies, Section 3.1) and in the long run (with free entry, Section 3.2). Section 4 analyzes the case of markets for horizontally differentiated goods. The result holds for the short run (closed Bertrand oligopolies, Section 4.1) but not always for the long run (Section 4.2). Section 5 concludes, discussing consequences for welfare and optimal taxation, and outlines the lines along which further work could be developed.

## 2. Theoretical framework

The introduction presented the intuition behind the differing incidence of per unit and ad valorem consumption taxes. The key property is the price-elasticity of the tax schedule. Ad valorem consumption taxes

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